Topic: Use Inner Heliospheric Observations to better constrain Coronal Mass Ejection (CME) and Solar Energetic Particle (SEP) Event models.

Project Title:
Proton Spectra in Ground-Level Enhanced Solar Energetic Particle Events and Implications for Astronaut Radiation Exposure and Storm-Shelter Design

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Project Information:
Ground-level events (GLEs) are very large solar energetic particle (SEP) events in which the proton spectrum extends beyond ~400 MeV with sufficient intensity to generate increased signals in terrestrial detectors that count secondary neutrons produced through interactions in the Earth's atmosphere. Although GLEs have been recorded by the world-wide neutron-monitor network for more than 50 years, they remain controversial in terms of how the origin of these very high-energy particles compares with that of particles below ~100 MeV that are typically observed by satellites. Nearly all of the SEP events in the historical record that potentially pose a significant radiation hazard for astronauts have been GLEs. Yet, as highlighted in a recent National Research Council report "Managing Space Radiation Risk in the New Era of Space Exploration" (van Hoften et al., 2008), the radiation-hazards community typically uses exponential spectral forms for these events that are too soft at high energies and inconsistent with the neutron monitor observations. As demonstrated in the NRC report, these erroneous spectral forms can lead to severe under-design of radiation storm shelters meant to protect astronauts during periods of extended SEPs, such as October 1989. The NRC report recommended that NASA re-evaluate these spectra by combining satellite measurements with neutron monitor observations. We have recently developed new data analysis techniques to do this. We propose to apply these new techniques to the entire historical database on GLEs, so as to provide a library of absolutely-normalized proton spectra for ~50 GLEs, thereby providing a new tool to the radiation-hazards community for evaluating the efficacy of radiation-shelter design. This proposal is submitted as an LWS "Independent Investigation." This proposed research directly supports NASA Strategic Sub-goals 3B, 3C, and 3F.

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